

Action, the added material “a non-uniform flow rate” in claims 1, 7, 17 and 44 is “not supported by the original disclosure.” (Office Action at 2). This objection and the accompanying new matter claims rejection are traversed.

The material “a non-uniform flow rate” in claims 1, 7, 17 and 44 is not new matter under 35 U.S.C. § 132. The addition of an inherent characteristic, such as an inherent function or physical property, in a patent application which does not necessarily discloses that function or property, is not considered new matter. *See* M.P.E.P. § 2163.07(a).

In the claimed invention, the added material is supported by the original disclosure as being an inherent characteristic of the process of reducing surface contamination. In the Detailed Description, Applicant states numerous times that the upper portion of the etching solution rapidly flows out of the etching bath apparatus because the flow rate is “significant” as a result of the “sudden release” of the upper wall. (Application at 10, lines 15-20; at 12, lines 26-27; at 14, lines 12-15). Applicant also notes in the Detailed Description that “the overflow etching solution (is) cascading over the edges of the upper wall components” of the etching bath apparatus. (Application at 11, lines 16-18; at 13, lines 21-22; at 15, lines 26-27). A sudden release of a wall component or of a slideable door that results in a cascading overflow of the etching solution inherently implies that the velocity of the overflow solution rapidly increases from a first value, for example zero (at the air/liquid interface before the sudden release) to a second higher value, i.e. a non-zero value. This is also because, at any time subsequent to the point of sudden release, the volume of the overflow solution has a potential energy $(\rho\Delta V)g\Delta x$, where ρ is the fluid density, ΔV is the volume, g is the gravitational acceleration and Δx is the distance traveled by the overflow solution. Since the volume and distance traveled by the overflow solution change ($\Delta V, \Delta x$), so does the potential energy which defines the flow velocity. Since the flow rate is function of the velocity of the fluid, it follows that a sudden release of a wall component or of a slideable door cannot result in a uniform flow rate of the overflow solution. Accordingly, the non-uniformity in a flow rate of a suddenly

released fluid is an inherent characteristic of such fluid and the addition of this limitation is not new matter.

Claim 3 is objected to under 37 C.F.R. 1.75 as being a “substantial duplicate” of claim 2. (Office Action at 2). The objection is traversed.

Claim 3 and claim 2 depend on independent claim 1 and recite a “cleaning bath” and an “etching bath,” respectively, used to rapidly remove at a non-uniform flow rate the upper portion of a semiconductor processing fluid present in such cleaning bath or etching bath. The two claims are not duplicates because they do not cover the “same thing” and the language of the claims does not contain “a slight difference in wording.” *See* M.P.E.P. § 706.03(k). In the semiconductor processing industry, an etching step is not the equivalent of a cleaning step. Similarly, an etching bath is not the “same thing” as a cleaning bath. Claims 2 and 3 do not have “a slight difference in wording,” and the claims are not duplicated.

Claims 1-10, 16, 17-20, 26, 27 and 44 stand rejected under 35 U.S.C. § 112, second paragraph, because the claimed limitation “a non-uniform flow rate” as recited in claims 1, 7, 17 and 44 “does not contain a written description of the invention in full, clear concise manner.” (Office Action at 3). Claims 2-6, 8-10, 16, 18-20, 26 and 27 stand rejected as depending on rejected base claims. The rejection is traversed for the reasons detailed above with respect to the rejection of the base claims under 35 U.S.C. § 132. The language of the specification quoted above is a written description of a non-uniform flow rate for the reasons noted. Accordingly, withdrawal of this rejection is traversed.

Claims 17-27 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Office Action asserts that the phrase “predetermine” (sic) renders the claims indefinite because “it is unclear whether the limitation(s) following the phrase are part of the claimed invention.” (Office Action at 3). The rejection is traversed.

The claim limitation “predetermined time” referred by the Office Action is not indefinite. According to the language of claims 17, 21, 22, 23, 24 and 25, the “predetermined time” is the time for “contacting said semiconductor wafer with said etching fluid.” Thus, this “predetermined time” is the actual etching time necessary to etch a semiconductor wafer with the etching fluid. Reference to this “predetermined time” is made in the Detailed Description of the application as to “a period of time sufficiently to effectively etch the wafers.” (Application at 8, lines 11-12). Further, in the Comparative Example 1 and the Example 1 of the Detailed Description, an exemplary “predetermined time” for etching the wafers is given as 60 seconds. (Application at 18, lines 15, 25). Thus, the limitation “predetermined” as used in the claimed invention is not indefinite.

Claims 1, 2, 4-9, 14, 17-20, 24, 26 and 44 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Nishizawa et al. (U.S. Patent No. 5,275,184). The rejection is traversed.

The claimed invention relates to a method for reducing contaminants from the air/liquid interface in a wet etching bath. As such, amended independent claim 1 recites a method for “rapidly removing at a non-uniform flow rate an upper portion of the semiconductor processing fluid” present in a processing bath. Similarly, amended independent claim 7 also recites a method for “reducing the contamination on a semiconductor wafer” by “rapidly removing at a non-uniform flow rate an upper portion of said etching fluid from said wet etching bath to remove contaminants from the surface of said wet etching bath.” Amended claim 17 also recites a method for etching a semiconductor wafer with an etching fluid, a portion of which being “rapidly removed . . . at a non-uniform flow rate.” Further, amended dependent claim 8 states that, during the process, “a substantial portion of said etching fluid is removed.” Such rapid and sudden removal, which has an attendant change in velocity of the processing fluid, may be accomplished in a variety of ways, for example, by “sliding a door located at an upper portion of said bath,” as recited in independent claims 13 and 23, by “hingedly releasing a door located at an upper portion of said bath,” as recited in independent claims 12 and 22,

or by “telescopically collapsing sidewalls” of a vessel, as recited in independent claims 15 and 25. This sudden change in velocity causes “the surface tension and eddy current forces holding the contaminants at the air/liquid interface are cleaved and the contaminants flow into the outer weir where they may be collected.” (Application at 10, lines 21-25).

Nishizawa et al. (“Nishizawa”) does not disclose any of the limitations of the claimed invention. Nishizawa discloses an “apparatus for treating a wafer surface” (Col. 3, line 30) and “a system capable of rapidly substituting treatment solutions” (Col. 3, lines 19-20), but not a method for “rapidly removing at a non-uniform rate an upper portion” of the etching fluid, as independent claims 1, 7, 11-15, and 17 recite. In fact, Nishizawa discloses a “uniform treatment solution flow container having an inlet and an outlet for a treatment solution . . . for containing a uniform flow of the treatment solution.” (Col. 3, lines 32-35). According to Nishizawa, the “old treatment solution inside the container is rapidly displaced by the new treatment solution.” (Col. 3, lines 54-55). However, the displacement of the old treatment solution has a uniform flow because “the treatment solution forms a uniform flow in the container.” (Col. 3, lines 56-57). Further, Nishizawa uses a “treatment solution at constant velocity to the inlet of the treatment solution bath” (Abstract at 5-6) that requires the displacement of the old treatment solution at a constant velocity, which in turn cannot acquire a non-uniform flow attendant a sudden change in flow velocity, as in the present invention. In sum, the present invention is not anticipated by Nishizawa.

Claims 10, 16 and 27 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) in view of Itoh et al. (U.S. Patent No. 5,795,401). The rejection is traversed.

The claimed invention would not have been obvious over Nishizawa in view of Itoh. First, Nishizawa is silent about the rapid removal of contaminants by opening a valve, hingedly releasing a door, sliding a door, or telescopically collapsing an etching bath. Second, even if Itoh recites using a paddle, Itoh does not refer to the removal of contaminants from the etching bath. Itoh merely refers to the scrubbing of a wafer surface

using a rotary brush while pressure is applied by jetting a fluid on the other surface of the wafer. Third, Itoh does not teach or disclose rapidly removing of a substantial portion of the etching liquid. Itoh does not even mention an etching fluid. Itoh refers only to a wash liquid that is purified water and that comes into contact with a rotary brush that cleans the wafer surface. Thus, there is no teaching or suggestion in either of these two references for the claimed subject matter.

The references are also not combinable in view of the diverse areas involved in each reference. Nishizawa refers to wafer surface treatment by using at least two different solutions. Itoh, on the other hand, refers to the actual physical cleaning and scrubbing of the wafer surface by mechanical means such as a cylindrical rotary brush. It is clear, therefore, that the rejection is based on picking and choosing selected portions of each reference, without regard to the totality of teachings of the references, in an attempt to improperly use hindsight to reconstruct the invention. Accordingly, a person of ordinary skills in the art could not have been motivated to combine Nishizawa with Itoh, and withdrawal of this rejection is respectfully requested.

Claims 11 and 21 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) in view of Mohindra et al. (U.S. Patent No. 5,958,146). The rejection is respectfully traversed.

Mohindra et al. (“Mohindra”) discloses a cleaning technique for a semiconductor wafer that uses a hot or heated liquid in conjunction with a carrier gas which includes a cleaning enhancement substance. Mohindra discloses the use of control valves in the method of cleaning the semiconductor wafers, and the Office Action points out that “it would have been obvious to one ordinary skill in the art . . . to have provided Nishizawa et al. reference with a valve as taught by Mohindra et al. because the use of valve would have provided another method of removing contaminants from the top of the wafer etching bath.” (Office Action at 9). However, the control valves in Mohindra are not used for the rapid removal of contaminants from an upper portion of the etching fluid, as in the claimed invention. Rather, the control valves in Mohindra are used to allow a fluid

to enter a filter bank, after the fluid was heated in a heater, and then into a wet processor. (Col. 5, lines 47-48; Col. 6, lines 29-35). Undoubtedly, the control valve in this reference merely “meters the carrier gas to the wet processor,” and not a fluid, as the claimed invention discloses. Further, the control valve in Mohindra is not used to remove any portion of an etching fluid, and surely does not rapidly remove any contaminants, as it merely allows passage of a fluid from a filter bank into a processor. Accordingly, there is nothing in the combination of Nishizawa and Mohindra, without the improper use of hindsight reconstruction, to motivate a person of ordinary skills in the art to arrive at the claimed method.

Claims 12, 15, 22 and 25 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over Nishizawa et al. (U.S. Patent No. 5,275,184) in view of Hayami et al. (U.S. Patent No. 5,474,616) (“Hayami”). The rejection is respectfully traversed.

Hayami teaches a method for rinsing plate-shaped articles, such as semiconductor wafers, as well as cleaning equipment for the rinsing method. (Col. 2, lines 40-43). For this, Hayami uses a cleaning bath in which streams are directed upward from orifices of a feed pipe located near the bottom of the cleaning bath. (Col. 6, lines 1-4; Figures 41-42). The diameters of the orifices are adjusted “so that the jetting pressure of the cleaning water at all the orifices are uniform.” (Col. 6, lines 11-14). Most importantly, Hayami specifically notes that “it is necessary to stably maintain a state where a part of the surface of the cleaning water bulges so as to form uniform streams on the surface of the cleaning water.” (Col. 7, lines 13-16). Thus, while these uniform streams which are directed toward the rear and front walls are formed on the surface of the cleaning water, the semiconductor wafers are “gradually brought into the cleaning water.” (Col. 14, lines 40-45).

The claimed invention would not have been obvious over Nishizawa in view of Hayami. First, both Nishizawa and Hayami are silent about the rapid removal of contaminants by “hingedly releasing a door” or by “telescopically collapsing sidewalls of a vessel,” as amended independent claims 12, 15, 22 and 25 recite. Second, Hayami does

not teach or disclose the rapid removal of an upper portion of a semiconductor processing fluid, as amended independent claims 12, 15, 22 and 25 recite. Hayami does not even teach or disclose a method for “etching a semiconductor wafer,” as amended independent claims 22 and 25 recite. Hayami refers only to water as the rinsing/cleaning liquid and the water in Hayami is not rapidly removed.

The references are also not combinable in view of the diverse areas involved in each reference. Nishizawa refers to water surface treatment by using at least two different solutions. Hayami, on the other hand, refers to the rinsing and cleaning of the wafers after the step of etching such wafers. It is clear, therefore, that the rejection is based on picking and choosing selected portions of each reference, in an attempt to improperly use hindsight to reconstruct the invention. Accordingly, a person of ordinary skill in the art would not have been motivated to combine Nishizawa with Hayami and withdrawal of this rejection is respectfully requested.

New independent claims 48 through 60 have been added. These claims recite the invention in terms of the rapid change in velocity of an upper portion of the bath fluid, at the point of removal, from a first velocity value, for example a zero value, to a second higher value. The subject matter of these claims is also supported in the application as filed, and it is also not anticipated by, or rendered obvious from, any of the cited references.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Dated: February 21, 2001

Respectfully submitted,

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